the same as the mean of two observations of the next lower class. As many as twenty authorities have been made use of, for some of the stars, tho it is stated that when a star had been many times observed, some of the less important catalog places were not included. The deduced places, with the epochs and the respective numbers of observations, have been tabulated. The inclusion of the magnitudes would have made the present results of greater interest. These will probably be printed in the final catalog, and one can always look them up in some authority of good weight, by referring to the tabulation now published.

The Cincinnati positions are of recent date, and the prompt reduction and publication of the work will be valued by present investigators, and they are certainly very creditable to the small force of astronomers attached to the observatory.

R. H. TUCKER.

October 30, 1915.

BLACKBURNE'S TABLES.

There are many sets of tables, compiled for use in calculating a ship's position at sea, in addition to the standard works, such as *Bowditch's Navigator,* which provide the essentials, when used in combination with the Nautical Almanac. The problem in all these treatises is to give methods that can be employed without any exact knowledge of the theories involved. No study of trigonometry is required usually for the ability to calculate a ship's position, tho every detail may be said to be based upon that science; and the use of logarithms does not imply any knowledge of the construction of the logarithmic tables, to which the ship's officer constantly refers.

The tables calculated by Capt. H. S. BLACKBURNE, of New Zealand, have been designed for help in some of the problems out of the ordinary routine, as well as to illustrate the inaccuracy which results from many of the usual methods. In general they are for the purpose of combining two or more observations, made out of the meridian, and the Sun, Moon, or stars may be observed.

The usual process on a sailing ship is to get the latitude from the noon observation of the Sun, and the longitude by

combination with the morning "sights." This involves, of course, a consideration of the run of the ship during the interval, which is ordinarily taken from the record of the automatic log, trailed astern. Few captains of the old style include an afternoon observation, which would add such a good check to the earlier determination.

My own remembrance of the working of a ship's position is still clear, when as a boy of fourteen, with no conception of trigonometry as yet, I learned by long practice to get the observations of the Sun, and, lying often on the cabin floor in rough weather, with the chart spread out, to follow thru the dizzy processes, and enter the correct columns of the assigned tables, and carry forward the relatively simple computations, until the pencil dot could be placed on the white chart, marking the place of the ship at noon. It was my introduction to astronomy, and it has been a pleasure since, on steamship voyages, to take up some of the details again, and amplify the methods, with some understanding of what we were driving at.

Modern steamship officers do much more thoro work; the afternoon sights of the Sun are generally obtained when possible, and it is quite usual to add the observations of the bright stars near twilight to strengthen the results.

On one voyage, running north for New York, I think we employed every method by star observation that the available books on navigation could furnish.

The chief engineer's record is also valuable to get the place by "dead reckoning," since the number of revolutions of the screw under normal conditions of loading, and of weather, gives a good check upon the distance run. Also, on a steamship, the dead reckoning is much simpler than on a sailing vessel, as the course may be run unchanged by variation in the wind. Only the force of the wind need be taken into account.

BLACKBURNE lays stress upon these extra meridian observations, and refers to three wrecks of steamers in three years that might have been avoided, had every opportunity been employed for determining the position of the ship.

A single star altitude out of the meridian can give an approximate position, when combined with the chronometer

longitude. But, of course, several stars will combine to give higher precision, and the requisite checks.

In passing, it may be said that seamen are apt to expect too great accuracy for the single determination; the fact that several officers will obtain good agreement from their simultaneous observations of the Sun is misleading, since the presence of systematic errors, that may affect all the determinations, is not often recognized. The combined result may give the position of the ship within a probable error of three miles, and that should be considered fairly good work.

SUMNER'S method of obtaining a position by two observations is much recommended, by the author of these tables. The practice of employing it mainly in the high latitudes, while general, could be much extended; and instances are quoted of satisfactory results in the low latitudes, by observations which were carefully chosen to give the proper "cut" for the two position lines, whose intersection gives the ship's place on the chart.

The tables include those for finding the hour-angle and azimuth from the altitude, azimuth from the altitude with latitude known, and auxiliary tables for SUMNER'S method. All appear to be carefully and thoroly calculated.

The error in time and latitude, produced by assumed errors in the observations, are also discussed and tabulated. These details should be considered by navigators of the modern type, who give some thot to their work beyond the mere routine. When all is said and done, the careful captain wants a keen lookout on duty, when his calculations lead him to expect a landfall.

A pretty illustration of navigation was furnished when the Cunard ship Pannonia ran 270 miles out of her course by wireless call to rescue the Spanish steamer Balmes, on fire, northeast of the Bermudas. Each position was evidently well fixed, for the Pannonia swung off at midnight, and ran till seven the following night, when the mast-head light of the Balmes was picked up, only half a point off the course; the flare from the distressed vessel following our mast-head hail by not over a quarter of a minute. The last twilight observations had been reduced, and, actually, the slight error in these had in-

dicated a small change of our course, which nearly accounted for the half point of deviation.

With our modern big ships, and the expertness of those who control them, every help to accurate navigation on the broad ocean will be welcomed, and sailors and landsmen should be grateful for the benefit such tables may be to the navigator.

R. H. TUCKER.

November 1, 1915.

AN INTRODUCTION TO THE STUDY OF VARIABLE STARS.[1]

In honor of the fiftieth anniversary of the founding of Vassar College, a collection of notable volumes is being published by Vassar Alumnæ. Miss FURNESS's *Introduction to the Study of Variable Stars* is one of these, and if it is typical, Vassar College has reason to be proud of the series.

The work is "the outcome of several years of teaching the subject," and its purpose and scope are well suggested by its title. It is not a comprehensive treatise such as the one now being published by Father HAGEN *(Die Veränderliche Sterne),* but is a general introductory book (the only one published in the English language) which is suited to the needs of teachers wishing to present the subject of variable star study to a class in a practical way, and to amateurs who, without special training in astronomy, wish to make their observations of the stars of scientific value. It should also appeal to the general reader, for it contains a great amount of interesting information put into language that is clear as well as precise.

The earlier chapters of the book deal not only with the subject of stellar variation, but with a variety of other topics,—the principles of spectrum analysis, star charts and catalogs, both visual and photographic, the early history of stellar magnitude, the principles of polarized light, upon which many photometers are based, etc. The treatment of these questions is avowedly not comprehensive, but enuf is said to give the student the knowledge needed to understand the application to the subject of variable stars. Furthermore, reference is always made to books accessible in any good library wherein these matters may be studied in more detail.

[1] By CAROLINE E. FURNESS, Ph.D., Director of the Vassar College Observatory. xv +, 327 pp., 8 vo., C2, $1.75. HOUGHTON MIFFLIN COMPANY, 1915.